(11) Patent Kokai [laid-open] Publication Number: Hei 3 [1991]-128212

(12) PATENT KOKAI PUBLICATION (A)

(19) JAPANESE PATENT OFFICE (JP)

(21) Patent Application Number: Hei 1 [1989]-268399

(22) Patent Application Date: Hei 1 (1989) October 16

(43) Patent Kokai Publication Date: Heisei 3 (1991) May 31

(51) Int. Cl.[5]	ID Codes	Sequence Nos. for Office Use
B 29 C 39/10		6639-4F
39/24		6639-4F
G 02 B 3/08		7036-2H
// B 29 K 105:32		
B 29 L 11:00		4F

Number of Claims: 2 (Total 5 pages [in Japanese original])
Examination Request: Not Requested

(54) TITLE OF THE INVENTION
MANUFACTURING METHOD OF LENS SHEET
[Len sheet no seizohoho]

(71) Applicant
Mitsubishi Rayon Kabushiki Kaisha [Japanese Company or corporation]
3-19, 2-chome, Kyobashi, Chuo-ku, Tokyo

(72) Inventor
Maruso HAMADA
c/o Mitsubishi Rayon Kabushiki Kaisha
1-60, 4-chome, Sunadabashi, Higashi-ku, Nagoya-shi, Aichi-ken

(72) Inventor
Osamu KOTANO

Same as the above

[Amendments: There are no amendments attached to this patent. Translator's note]

[Note: All names, addresses, company names, and brand names are translated in the most common manner. Japanese language does not have singular or plural words unless otherwise specified with numeral prefix or general form of plurality suffix. Translator's note]

SPECIFICATION

1. TITLE OF THE INVENTION
MANUFACTURING METHOD OF LENS SHEET

2. CLAIMS
1, According to a manufacturing method that lays UV ray curing-type resin solution between a lens mold and a transparent substrate, and at the same time, forms a lens part on at least one plane of the transparent substrate through irradiation of UV rays, the manufacturing method of lens sheet is characterized by the fact that above-explained lens mold and transparent substrate are arranged opposite to each other with a void, and a nozzle having a discharge port is installed in between this to emit UV ray curing-type resin solution from this nozzle to pack said resin solution within said void while moving this.

2. The manufacturing method of lens sheet that is described in the claim item 1, wherein UV ray curing-type resin solution is emitted from both sides by using a nozzle having discharge port on both planes.

3. DETAILED EXPLANATION OF THE INVENTION
(FIELDS OF INDUSTRIAL APPLICATION)

This invention relates to the manufacturing method of lens sheet on which surface, fine lens part is formed including a fine lens part is formed and is used for collection of solar light, various light source devices, or Fresnel lens used for transmission-type screen and the like, and lenticular sheet used for transmission-type or reflective-type screen and the like.

(PRIOR ART)

The lens sheet that is used for above-explained fields uses transparent resin materials such as acryl resin, polycarbonate resin, vinyl chloride resin, or styrene resin and the like, and uses a method to extrusion mold or injection mold by using a mold having the shape of lens sheet, or a method to heat and pressure a sheet material along with lens mold for a thermal transfer, or a method to cut a lens shape by using a cutting tool directly on the sheet material have been known.

However, according to above-explained methods, they present such problem points as they generally tend to require a large scale manufacturing device, and as it accompanies heating or pressure application operation, manufacturing cycle become long to increase manufacturing cost.

Therefore, a method to form a lens part with a UV ray curing-type resin on a surface of existing resin substrate has been known recently (make reference to the publications of Japanese patent applications Kokai Sho 54 [1979]-156651, Kokai Sho 61 [1986]-177215, and Kokai Sho 62 [1987]-238502).

(SUBJECTS SOLVED BY THIS INVENTION)

However, problematic point when manufacturing a lens sheet by using above-explained UV ray curing-type resin is that it is difficult to remove air bubbles that generate when injecting UV ray curing-type resin in between a lens mold and a transparent substrate. And therefore, of the above-explained prior arts, according to the publication of Japanese patent application Kokai Sho 61 [1986]-182608, injection of UV ray curing-type resin under reduced pressure is proposed; however, when manufacturing a large size lens sheet, equipment for pressure reduction ends up as large scale device and is difficult to contribute toward manufacturing cost reduction. Above all, in the case when thickness of to-be cured resin layer happens to be fairly thick, although effect of defoaming is recognized under reduced pressure, when a resin layer happens to be thin as in the case of lens part only, migration of air bubbles is inhibited by concaveness/convexes of the lens mold to present a difficult point of significantly reducing the efficiency of defoaming. In this case, purpose of reducing material cost by improving productivity through forming of only the lens part with a UV ray curing-type resin to start with cannot be met.

Based on such circumstance, this invention offers a method that spreads UV ray curing-type resin in a lens mold, and when a transparent substrate is piled, it does not allow an involvement of air bubbles in lens mold plane and between lens mold and transparent substrate, and above all, it does not reduce production efficiency.

(MEANS USED TO SOLVE THE SUBJECTS)

As a cause for generating air bubbles in a lens mold plane and between lens mold and transparent substrate, excluding the case when water repellent substance is adhered to the lens mold or surface of transparent substrate, involvement of air bubbles when spreading resin solution in a lens mold and generation of air bubbles caused by concave part of concave/convex on the surface of resin solution when piling a lens mold with a transparent substrate after completion of injection of resin solution can be mentioned. And therefore, if it is possible to accurately control the injection speed of the resin solution to the lens mold and location where resin solution comes in contact with a transparent substrate can be arranged in linear manner, it is possible to pile lens mold and transparent substrate without generating air bubbles.

That is to say, this invention was conducted based on such aspects; and according to the manufacturing method that lies UV ray curing-type resin in between a lens mold and a transparent substrate and forms a lens on at the least one plane of the transparent substrate through irradiation of UV rays, manufacturing method of lens sheet is characterized by the fact that above-explained lens mold and transparent substrate are arranged to oppose each other via void, and a nozzle having a emission port is arranged in between these to emit UV ray curing-type resin solution from this nozzle, and to pack said resin solution within a void by moving this. It is designed to control the speed of spread of resin solution in the lens mold accurately through that, and at the same time, as it becomes possible to arrange the contact point of resin solution with a transparent substrate in a linear manner, UV rays can be irradiated to polymerize and cure to allow its spread without leaving air bubbles between lens mold plane or transparent substrate to enable to form this as one body.

This invention is explained below with reference to attached Figures.

Figure 1 through Figure 8 show schematic views of this invention's processes.

First of all, lens mold (1) that is equipped with a mold plane to form a lens sheet shape is readied. As this lens mold (1), the ones made of metal sheets such as aluminium, brass, or copper and the like, or synthetic resins such as silicon resin, urethane resin, epoxy resin, fluorine resin or polymethyl pentene resin may be used.

Then, transparent substrate (2) that is almost the same size as that of above-explained lens mold (1) is readied. Although material for this transparent substrate (2) may be of glass sheet that transmits UV rays, transparent synthetic resin sheets or films of acryl resin, polycarbonate resin, or vinyl chloride resin and the like are generally used.

According to this invention, lens mold (1) is installed by tiling 5 ~ 30° against horizontal plane first of all as illustrated in the Figure 1.

Then, as illustrated in the Figure 2, said transparent substrate (2) is installed opposite to the lens mold (1) in such manner so the top part of the gradation of lens mold (1)would show a wider gap compared to the bottom part of said gradation. At this time, it is necessary to make certain that the gap at bottom part of the gradation would not diminish. In addition, it is preferable when between lens mold (1) and transparent substrate (2) would show about $1 \sim 10^{\circ}$ angle.

The nozzle (4) that is used in this invention may be of such that has continued emission ports with small aperture or may be the one having continued slit-form opening part as illustrated in the Figure 4, and may be the one of which emission port is arranged at both sides of cylinder, and it is all right when location of emission port on both sides are set within a range of $180 \pm 30^{\circ}$. It is necessary to set the aperture of the nozzle (4) for its diameter, width, and number of holes in accordance with viscosity of UV ray curing-type resin solution that is used.

Spread of UV ray curing-type resin solution (3) can be conducted by moving a nozzle (4) at bottom part of gradation as illustrated in the Figure 5 to start emission of UV ray curing-type resin solution.

Regarding UV ray curing-type resin solution that is used at this time, polyester acrylate group, epoxy acrylate group, or polyurethane acrylate group and the like is used; and it is preferable when viscosity at the time of flow down is within arrange of $10 \sim 400$ cps, and its transparency after curing remains high. The UV ray curing-type resin solution (3) that is used at this time must be subjected to a thorough defoaming beforehand, and at the same time, dirt in the solution must be filtered with a filter.

When flow down of the resin solution (3) becomes stable, nozzle (4) can be shifted upward on the gradation gradually while continuing to flow down said resin solution, and transparent substrate (2) is gradually pressed with a roll (5) as illustrated in the Figure 6. This roll (5) may be of either metal made or rubber made; and it may also be a squeegee with a curvature at the top end; however, it is necessary to avoid installation immediately above the nozzle as it may inhibit the movement of nozzle.

The resin solution (3) that is discharged from the nozzle (4) must be adjusted to become excess against planned coating weight. And therefore, excess resin solution (3) is made to over flow either from lower part or surrounding part of the gradation. At this time, it is recommended that the excess resin solution (3) is collected from resin receptor (7) to be defoamed and filtered again for recycle purpose.

When nozzle (5) is raised to the top end, as illustrated in the Figure 7, emission of resin solution should be stopped to gently remove the nozzle from between lens mold (1) and transparent substrate (3).

Then, after flowing out excess resin solution (3) between lens mold (1) and transparent substrate (2) with a roll (5), gradation of lens mold (1) is returned to horizontal.

Through above-explained processes, it is possible to pile a transparent substrate (2) without involving air bubbles among lens mold (1) plane, and UV ray curing-type resin solution (3) and transparent substrate (2).

Then, as illustrated in the Figure 8, UV ray is irradiated (8) from above transparent substrate (2) to cure; and after curing, it is removed from the mold to take out lens sheet; and the lens sheet that is given through this method shows formation of lens on the transparent substrate (2) as one body, and above all, it is excellent showing no bubbles at the lens part.

(EXAMPLES)

Examples of this invention are explained below in reference with Figure 9 through Figure 11.

First of all, as illustrated in the Figure 9, lens mold (1) on which brass sheet surface showing 3 mm sheet thickness and 1100 x 800 mm size, Fresnel lens mold plane was cut, and a support base (6) that is of a shallow dish to enable to contain this lens mold (1) and can attach and detach 2 top/bottom side frames (6A), and at the same time, have legs (6B) that enables a gradation fixing that is arranged at the bottom plane of the base were readied; and lens mold (1) is set here. Then, legs (6B) were raised to hold 15°gradation of the support base (6), and side detached of frame (6A) becomes top/down direction, and frame (5) and resin receptor (7) are set in such a way so the bottom end would come in contact with resin receptor (7).

As a nozzle (4) for discharge of UV ray curing-type resin solution (3), 5 mm hole is placed on a polyacetal resin rod (10 mm diameter) made by Nihon Polybenco K.K. [transliteration], and nozzle (4) with 1 mm cut groove was prepared at its both sides, and "WP2040 model" gear pump made by Daito Metal K.K. was used to transport UV ray curing-type resin solution (3) to said device; and in addition, as a line filter, "TCW10RSS" made by Toyo Roshi K.K. was connected to flow down UV ray curing-type resin solution (3) at 20 liter/minute speed. The composition of UV ray curing-type resin solution (3) used at this time is as shown below.

* "UV-3000B" urethane acrylate made by Nihon Gosei Kagaku K.K. 30 weight %
* "Diabeam 4117" [transliteration] bisphenol A group acrylate made by Mitsubishi Rayon K.K. 10 weight %
* "Diabeam 2100" [transliteration] monomer made by Mitsubishi Rayon K.K. 60 weight %
* "Darocur 5117" photo curing catalyst made by Merc Co. 1.5 weight %

(based on sum of above-explained two monomers)

Then, as illustrated in the Figure 10, "Acrylite #000" [transliteration] (3 mm thickness) made by Mitsubishi Rayon K.K. that is with almost equal size as that of the lens sheet mold (1) was placed quietly in a manner soothe nozzle (4) could be sandwiched between these.

Regarding said nozzle (4), it was made to flow down UV ray curing-type resin solution (3) at about 1 m/minute through use of a timing belt and a motor (equipped with speed adjustment device and deceleration device) "US425-401" made by Oriental Motor K.K. that connected, and this was made to rise while ironing resin solution with a rubber roller with 50 mm diameter that was connected.

At the point when nozzle (4) reached top end of transparent substrate (2), emission of UV ray curing-type resin solution (3) from the nozzle (4) was ceased, and nozzle (4) was extracted from between lens mold (1) and transparent substrate(2), and excess resin solution was pushed out with the roll (5) to collect this in a resin receptor (7), and then, gradation of the support base (6) was returned to its original state.

Then, UV ray was irradiated with UV ray lamp made by Western Quartz K.K. at 80W/cm irradiation intensity to cure. Then, it was removed from the mold to give a Fresnel lens sheet with no bubbles as illustrated in the Figure 11.

(EFFECTS OF THIS INVENTION)

As this invention shows a structure explained in details above, it shows such beneficial points that a lens part that includes no air bubbles can be formed with UV ray curing - type resin on a transparent substrate by this invention to enable to manufacture a lens sheet with good performance at fairly small scale equipment and good efficiency to enable to reduce production cost of lens sheet.

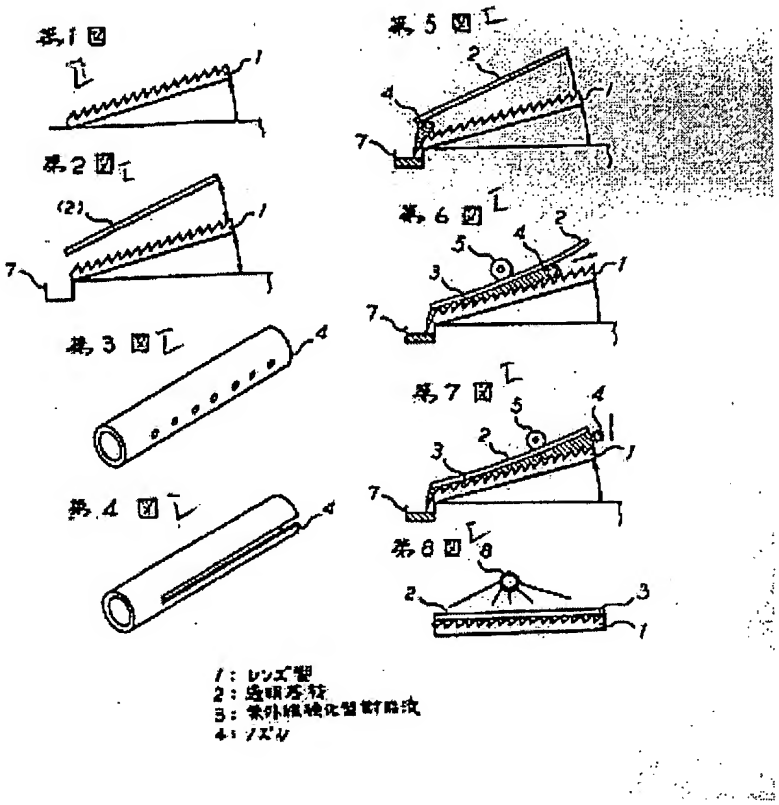
4. BRIEF DESCRIPTION OF THE FIGURES

Figure 1 through Figure 8 illustrate cross sectional views that shows schematic views of this invention's processes; and Figure 9 through Figure 11 illustrate processes of examples of this invention; and Figure 9 and Figure 10 illustrate diagonal view of support base and mold, and state of resin receptor; and Figure 11 illustrates a cross sectional view of thus given lens sheet.

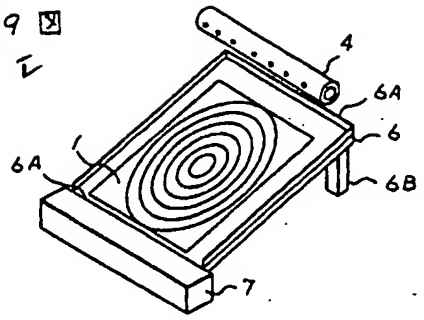
(1): lens mold, (2): transparent substrate, (3): UV ray curing-type resin solution, (4): nozzle, (5): roll, (6): support base, (6A): frame capable of detachment/attachment of support base, (6B): legs for adjustment of gradation of support base, (7): resin receptor, (8): UV ray lamp,

Figures 1 through 11

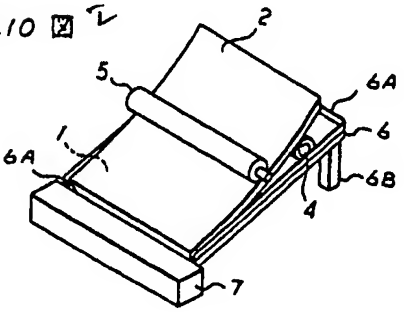
I: Figure



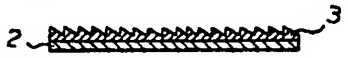
第9図



第10図



第11図



Translation requested by: Amber Nicholson for Carolyn A. Fischer, OIPC
Translation by: Mie N. Arntson, 512-331-7167